

CLAIMS

We claim:

1 1. A system for injecting fluid into, and producing fluid from, multiple
2 zones in a well bore, comprising:
3 a tubular completion string, said completion string having a production fluid
4 inlet port and an injection fluid outlet port;
5 a production fluid flow path within said completion string;
6 an injection fluid flow path within said completion string;
7 a production fluid bypass channel connecting a portion of said injection fluid
8 flow path above said production fluid inlet port to a portion of said
9 injection fluid flow path below said production fluid inlet port;
10 an injection fluid bypass channel connecting a portion of said injection fluid
11 flow path above said injection fluid outlet port to a portion of said
12 injection fluid flow path below said injection fluid outlet port;
13 a production fluid conduit, said production fluid conduit being adapted to shift
14 relative to said completion string to selectively conduct production
15 fluid from said production fluid inlet port to said production fluid flow
16 path; and
17 an injection fluid conduit, said injection fluid conduit being adapted to shift
18 relative to said completion string to selectively conduct injection fluid
19 from said injection fluid flow path to said injection fluid outlet port.

1 2. The injection and production system recited in claim 1, wherein said
2 production fluid conduit is slidably mounted in said completion string to selectively
3 conduct production fluid from said production fluid inlet port to said production fluid
4 flow path, by sliding longitudinally relative to said completion string.

1 3. The injection and production system recited in claim 1, wherein said
2 injection fluid conduit is slidably mounted in said completion string to selectively
3 conduct injection fluid from said injection fluid flow path to said injection fluid outlet
4 port, by sliding longitudinally relative to said completion string.

1 4. The injection and production system recited in claim 1, further
2 comprising:

3 a first packer surrounding said completion string above said production fluid
4 inlet port and said injection fluid outlet port; and
5 a second packer surrounding said completion string below said production
6 fluid inlet port and said injection fluid outlet port.

1 5. The injection and production system recited in claim 1, further
2 comprising:

3 a plurality of said production fluid conduits; and
4 a plurality of said injection fluid conduits.

1 6. The injection and production system recited in claim 5, wherein each
2 of said production fluid conduits is associated with an adjacent said injection fluid
3 conduit to comprise an associated pair of fluid conduits, and further comprising a
4 packer surrounding said completion string between adjacent said associated pairs of
5 said production and injection fluid conduits.

1 7. The injection and production system recited in claim 1, further
2 comprising a tubular production string within said completion string, wherein:
3 said production fluid flow path passes through said production string; and
4 said production fluid conduit is adapted to shift relative to said completion
5 string to selectively conduct production fluid from said production
6 fluid inlet port to said production string.

1 8. The injection and production system recited in claim 1, further
2 comprising a tubular production string within said completion string, wherein:
3 said injection fluid flow path passes through a space between said production
4 string and said completion string; and
5 said injection fluid conduit is adapted to shift relative to said completion string
6 to selectively conduct injection fluid from said space between said
7 production and completion strings to said injection fluid outlet port.

1 9. The injection and production system recited in claim 1, further
2 comprising a tubular production string within said completion string, wherein:

3 said injection fluid flow path includes a space between said production string
4 and said completion string;

5 said production fluid conduit passes through said space between said
6 production string and said completion string; and

7 said production fluid bypass channel bypasses said production fluid conduit
8 from a portion of said space above said production fluid conduit to a
9 portion of said space below said production fluid conduit.

1 10. The injection and production system recited in claim 1, further
2 comprising a tubular production string within said completion string, wherein:

3 said injection fluid flow path includes a space between said production string
4 and said completion string;

5 said injection fluid conduit passes through said space between said production
6 string and said completion string; and

7 said injection fluid bypass channel bypasses said injection fluid conduit from a
8 portion of said space above said injection fluid conduit to a portion of
9 said space below said injection fluid conduit.

1 11. The injection and production system recited in claim 1, wherein said
2 production fluid conduit is adapted for shifting under remote control to selectively
3 conduct production fluid from said production fluid inlet port to said production fluid
4 flow path.

1 12. The injection and production system recited in claim 11, further
2 comprising a hydraulic actuator adapted to remotely shift said production fluid
3 conduit.

1 13. The injection and production system recited in claim 1, wherein said
2 injection fluid conduit is adapted for shifting under remote control to selectively
3 conduct injection fluid from said injection fluid flow path to said injection fluid outlet
4 port.

1 14. The injection and production system recited in claim 13, further
2 comprising a hydraulic actuator adapted to remotely shift said injection fluid conduit.

1 15. A system for injecting fluid into, and producing fluid from, multiple
2 zones in a well bore, comprising:

3 a tubular completion string, said completion string having a production fluid
4 inlet port and an injection fluid outlet port;
5 a production fluid flow path within said completion string;
6 an injection fluid flow path within said completion string;
7 a production sleeve mounted within said completion string;
8 an injection sleeve mounted within said completion string;
9 a production sleeve bypass channel connecting a portion of said injection fluid
10 flow path above said production sleeve to a portion of said injection
11 fluid flow path below said production sleeve;
12 an injection sleeve bypass channel connecting a portion of said injection fluid
13 flow path above said injection sleeve to a portion of said injection fluid
14 flow path below said injection sleeve;
15 a production fluid conduit in said production sleeve, said production sleeve
16 being adapted to shift relative to said completion string to selectively
17 conduct production fluid from said production fluid inlet port to said
18 production fluid flow path via said production fluid conduit; and
19 an injection fluid conduit in said injection sleeve, said injection sleeve being
20 adapted to shift relative to said completion string to selectively conduct
21 injection fluid from said injection fluid flow path to said injection fluid
22 outlet port via said injection fluid conduit.

1 16. The injection and production system recited in claim 15, wherein said
2 production sleeve is slidably mounted in said completion string to selectively conduct
3 production fluid from said production fluid inlet port to said production fluid flow
4 path, via said production fluid conduit, by sliding longitudinally relative to said
5 completion string.

1 17. The injection and production system recited in claim 15, wherein said
2 injection sleeve is slidably mounted in said completion string to selectively conduct
3 injection fluid from said injection fluid flow path to said injection fluid outlet port, via
4 said injection fluid conduit, by sliding longitudinally relative to said completion
5 string.

1 18. The injection and production system recited in claim 15, further
2 comprising:
3 a first packer surrounding said completion string above said production and
4 injection sleeves; and
5 a second packer surrounding said completion string below said production and
6 injection sleeves.

1 19. The injection and production system recited in claim 15, further
2 comprising:
3 a plurality of said production sleeves; and
4 a plurality of said injection sleeves.

1 20. The injection and production system recited in claim 19, wherein each
2 of said production sleeves is associated with an adjacent said injection sleeve to
3 comprise an associated pair of sleeves, and further comprising a packer surrounding
4 said completion string between adjacent said associated pairs of said production and
5 injection sleeves.

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1 21. The injection and production system recited in claim 15, further
2 comprising a tubular production string within said completion string, wherein:
3 said production fluid flow path passes through said production string; and
4 said production sleeve is adapted to shift relative to said completion string to
5 selectively conduct production fluid from said production fluid inlet
6 port to said production string, via said production fluid conduit.

1 22. The injection and production system recited in claim 15, further
2 comprising a tubular production string within said completion string, wherein:
3 said injection fluid flow path passes through a space between said production
4 string and said completion string; and
5 said injection sleeve is adapted to shift relative to said completion string to
6 selectively conduct injection fluid from said space between said
7 production and completion strings to said injection fluid outlet port, via
8 said injection fluid conduit.

1 23. The injection and production system recited in claim 15, further
2 comprising a tubular production string within said completion string, wherein:
3 said injection fluid flow path includes a space between said production string
4 and said completion string;
5 said production sleeve bridges said space between said production string and
6 said completion string; and
7 said production sleeve bypass channel passes through said production sleeve
8 from a portion of said space above said production sleeve to a portion
9 of said space below said production sleeve.

1 24. The injection and production system recited in claim 15, further
2 comprising a tubular production string within said completion string, wherein:
3 said injection fluid flow path includes a space between said production string
4 and said completion string;
5 said injection sleeve bridges said space between said production string and
6 said completion string; and
7 said injection sleeve bypass channel passes through said injection sleeve from
8 a portion of said space above said injection sleeve to a portion of said
9 space below said injection sleeve.

1 25. The injection and production system recited in claim 15, wherein said
2 production sleeve is adapted for shifting under remote control to selectively conduct
3 production fluid from said production fluid inlet port to said production fluid flow
4 path.

1 26. The injection and production system recited in claim 25, further
2 comprising a hydraulic actuator adapted to remotely shift said production sleeve.

1 27. The injection and production system recited in claim 15, wherein said
2 injection sleeve is adapted for shifting under remote control to selectively conduct
3 injection fluid from said injection fluid flow path to said injection fluid outlet port.

1 28. The injection and production system recited in claim 27, further
2 comprising a hydraulic actuator adapted to remotely shift said injection sleeve.

- 1 29. A system for injecting into and producing from multiple zones in a
2 well bore, comprising:
- 3 a tubular completion string, said completion string having a production fluid
4 inlet port and an injection fluid outlet port;
- 5 a tubular production string within said completion string;
- 6 a production sleeve mounted on said production string;
- 7 an injection sleeve mounted within said completion string;
- 8 a plurality of bypass channels through said production sleeve and said
9 injection sleeve, in fluid communication with a space between said
10 production string and said completion string;
- 11 a production fluid conduit in said production sleeve, said production sleeve
12 being adapted to shift relative to said completion string to selectively
13 conduct production fluid from said production fluid inlet port to said
14 production string, via said production fluid conduit; and
- 15 an injection fluid conduit in said injection sleeve, said injection sleeve being
16 adapted to shift relative to said completion string to selectively conduct
17 injection fluid from said space between said production string and said
18 completion string, to said injection fluid outlet port, via said injection
19 fluid conduit.

1 30. A method for producing fluid from a production zone of a well bore
2 and injecting fluid into an injection zone of a well bore, said method comprising:

3 providing a tubular completion string, said completion string having a
4 production fluid conduit and an injection fluid conduit therein, said
5 completion string having an inlet port and an outlet port through a wall
6 thereof;

7 aligning said inlet port with a production zone of a well bore;

8 aligning said outlet port with an injection zone of said well bore;

9 pumping injection fluid into an injection fluid flow path within said
10 completion string;

11 selectively shifting said injection fluid conduit and said production fluid
12 conduit relative to said completion string to place said injection fluid
13 flow path in fluid flow communication with said outlet port, and to
14 place said inlet port in fluid flow communication with a production
15 fluid flow path in said completion string; and

16 injecting fluid through said outlet port into said injection zone and producing
17 fluid through said inlet port from said production zone.

1 31. The method recited in claim 30, further comprising:

2 providing a plurality of production fluid conduits and a plurality of inlet ports
3 in said completion string;

4 aligning said plurality of inlet ports with a plurality of production zones of a
5 well bore;

6 selectively shifting said plurality of production fluid conduits relative to said
7 completion string to place at least one said inlet port in fluid flow
8 communication with a production fluid flow path in said completion
9 string; and

10 injecting fluid through said outlet port into said injection zone and producing
11 fluid through said at least one inlet port from at least one said
12 production zone.

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1 32. The method recited in claim 30, further comprising:
2 providing a plurality of injection fluid conduits and a plurality of outlet ports
3 in said completion string;
4 aligning said plurality of outlet ports with a plurality of injection zones of said
5 well bore;
6 selectively shifting said plurality of injection fluid conduits relative to said
7 completion string to place said injection fluid flow path in fluid flow
8 communication with at least one said outlet port; and
9 injecting fluid through said at least one outlet port into at least one said
10 injection zone and producing fluid through said inlet port from said
11 production zone.

1 33. The method recited in claim 30, further comprising:
2 providing a plurality of production fluid conduits, a plurality of injection fluid
3 conduits, a plurality of inlet ports, and a plurality of outlet ports in said
4 completion string;
5 aligning said plurality of inlet ports with a plurality of production zones of a
6 well bore;
7 aligning said plurality of outlet ports with a plurality of injection zones of said
8 well bore;
9 selectively shifting said plurality of injection fluid conduits and said plurality
10 of production fluid conduits relative to said completion string to place
11 said injection fluid flow path in fluid flow communication with said
12 plurality of outlet ports, and to place said plurality of inlet ports in fluid
13 flow communication with a production fluid flow path in said
14 completion string; and
15 injecting fluid through said plurality of outlet ports into said plurality of
16 injection zones and producing fluid through said plurality of inlet ports
17 from said plurality of production zones.

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1 34. A method for producing fluid from a production zone of a well bore
2 and injecting fluid into an injection zone of a well bore, said method comprising:

3 providing a tubular completion string, said completion string having a
4 production sleeve and an injection sleeve therein, said completion
5 string having an inlet port and an outlet port through a wall thereof;

6 aligning said inlet port with a production zone of a well bore;

7 aligning said outlet port with an injection zone of said well bore;

8 pumping injection fluid into an injection fluid flow path within said
9 completion string;

10 selectively shifting said injection sleeve relative to said completion string to
11 place said injection fluid flow path in fluid flow communication with
12 said outlet port;

13 selectively shifting said production sleeve relative to said completion string to
14 place said inlet port in fluid flow communication with a production
15 fluid flow path in said completion string; and

16 injecting fluid through said outlet port into said injection zone and producing
17 fluid through said inlet port from said production zone.

1 35. The method recited in claim 34, further comprising:

2 providing a plurality of production sleeves and a plurality of inlet ports in said
3 completion string;

4 aligning said plurality of inlet ports with a plurality of production zones of a
5 well bore;

6 selectively shifting said plurality of production sleeves relative to said
7 completion string to place at least one said inlet port in fluid flow
8 communication with a production fluid flow path in said completion
9 string; and

10 injecting fluid through said outlet port into said injection zone and producing
11 fluid through said at least one inlet port from at least one said
12 production zone.

1 36. The method recited in claim 34, further comprising:
2 providing a plurality of injection sleeves and a plurality of outlet ports in said
3 completion string;
4 aligning said plurality of outlet ports with a plurality of injection zones of said
5 well bore;
6 selectively shifting said plurality of injection sleeves relative to said
7 completion string to place said injection fluid flow path in fluid flow
8 communication with at least one said outlet port; and
9 injecting fluid through said at least one outlet port into at least one said
10 injection zone and producing fluid through said inlet port from said
11 production zone.

1 37. The method recited in claim 34, further comprising:
2 providing a plurality of production sleeves, a plurality of injection sleeves, a
3 plurality of inlet ports, and a plurality of outlet ports in said completion
4 string;
5 aligning said plurality of inlet ports with a plurality of production zones of a
6 well bore;
7 aligning said plurality of outlet ports with a plurality of injection zones of said
8 well bore;
9 selectively shifting said plurality of injection sleeves relative to said
10 completion string to place said injection fluid flow path in fluid flow
11 communication with said plurality of outlet ports;
12 selectively shifting said plurality of production sleeves relative to said
13 completion string to place said plurality of inlet ports in fluid flow
14 communication with a production fluid flow path in said completion
15 string; and
16 injecting fluid through said plurality of outlet ports into said plurality of
17 injection zones and producing fluid through said plurality of inlet ports
18 from said plurality of production zones.